Japanese Patent Office
Public Patent Disclosure Bulletin

Public Patent Disclosure Bulletin No.: Hei 2-290138
Public Patent Disclosure Bulletin Date: November 30, 1990
Request for Examination: Not yet made
Number of Inventions: 1
Total Pages: 4

Int. Cl.3	Identification Code	FI
H02K 3/24	P 7829-5H	

Title of the Invention: Salient-Pole Rotary-Field Synchronous Machine
(21) Patent Application No.: Hei 1-105840
(22) Patent Application Date: April 27, 1989
(72) Inventor: Kanai, Hitoshi
c/o Toshiba Keihan Office
Suehiro-cho 2-4, Tsurumi-ku, Yokohama-shi, Kanagawa
(71) Applicant: Toshiba Corp.
72-banchi, Horikawa-cho, (illegible)-ku, Kawasaki-shi, Kanagawa
(74) Agent: Patent Attorney illegible (and one other)

Specification

1. Title of the Invention: Salient-Pole Rotary-Field Synchronous Machine

2. Scope of the Invention

In a salient-pole rotary-field synchronous machine having a field winding which is a wound conductor coated with insulation, heat dissipation plates being inserted or wound in one body between the conductors constituting the field windings, and a part of the heat dissipation plates is protruded from an outer circumference of the field windings.

3. Detailed Explanation of the Invention

Scope of the Invention

Industrial Field of Application

The present invention relates to a silent-pole rotary-field synchronous and, more particularly, relates to a configuration which improves the cooling and radiation capacity of a field winding.

Prior Art Technology

Fig. 6 is a cross-sectional view, showing a part of a silent-pole rotary-field synchronous in which a field winding is constituted by winding a pillar copper wire coated with insulation and the field winding is attached thereto.

As shown in the figure, for a field winding 1, magnetic pole insulation 3 is applied on the surface of a magnetic pole core 2. Subsequently, insulating collars 4a, 4b are inserted, and a pillar copper wire 5 coated with insulation is wound in a radius direction 6 and a width direction 7 along the surface of the magnetic pole core 2 so as to form steps.

The field winding 1 is heated by letting an exciting current flow while a synchronous is run. This heat is transmitted to the magnetic pole core 2 and the outer periphery 3 of the field winding 1, and is radiated inside the synchronous. Cooling wind inside the synchronous accelerates this radiation, and the cooling effects of the field winding 1 improve. In this case, cooling wind is flown only to the outer periphery 3 of the field winding 1 as a heat dissipation surface. Thus, when the field winding 1 has a plurality of turns in the width direction 7, a thermal grade by thermal conduction is generated at an insulated section constituting the field winding 1. Accordingly, the thermal grade becomes large in the width direction 7 of the field winding 1.

Problem Resolution Means

In order to make a synchronous lightweight and compact, the cooling of the field winding 1 is important. In case of the field winding 1 constituted by winding the pillar copper wire 5 coated with insulation, a temperature grade in the width direction 7 becomes large as the number of turns increases in the width direction 7. The field winding 1 is also cooled by radiation at the periphery 3 and thermal conduction to the magnetic pole core 2. However, due to this temperature grade, the temperature of the field winding 1 increases

as a whole, thus preventing it from being lightweight and compact. Thus, the solution thereof has been desired.

The object of the present invention is to provide a salient-pole rotary-field synchronous that reduces a thermal grade even with many turns in the width direction of a field winding and aims to make it lightweight and compact by improving the cooling capacity of the field winding as a whole.

Constitution of the Invention

Means to Solve the Problems

The present invention, in a salient-pole rotary-field synchronous having a field winding constituted by winding a conductor coated with insulation, provides heat dissipation plates among conductors constituting field windings in one body by inserting or rolling in the plates, and protrudes a part of the dissipation plates from the outer periphery of the field windings.

(Operation)

Since heat dissipation plates are inserted or rolled in among conductors of a field winding, a thermal grade may be reduced sharply in comparison with a conventional field winding. Standardized temperature distributions in the width direction inside a field winding are shown in Fig. 4 with an average of a field winding having no heat dissipation plates as 1.0 while comparing the one without the plates to the ones with the plates.

A conventional field winding is, as shown in Fig. 5a, coated with insulation on a conductor such as, for instance, a pillar copper wire, so that thermal conduction is not smooth and a thermal conduction path is mainly between wires in the width direction of this pillar copper wire. However, the field winding of the present invention, as shown in Fig. 5b, protrudes from an outer periphery of the field winding, thus increasing a radiating

area by the heat exchange with cooling wind. Additionally, a heat dissipation plate is inserted in respect to the radius direction of a magnetic pole (indicated as reference numeral 6 in Fig. 6). Thus, heat is conducted not only in the width direction of the field winding (indicated as reference numeral 7 in Fig. 6) but also in the radium direction of the pillar copper wire. Accordingly, the heat is transmitted in the width direction through the heat dissipation plate and is then radiated, so that a temperature grade is reduced

(Embodiment)

An embodiment of the present invention will be explained below by referring to figures. Fig. 1 shows a cross section of a part of an embodiment of the present invention.

In the figure, a field winding 10 has a magnetic pole insulation 3 at the surface of a magnetic pole core 2. Insulation collars 4a, 4b are inserted, and a pillar copper wire 5 coated with insulation is sequentially wound in a radium direction 5 and in a width direction 7 along the surface of the magnetic pole core 2. In the event of the winding, heat dissipation plates 11 as shown in Fig. 2 are rolled in or inserted together with the pillar copper wire 5 for every two steps of radial windings of a rotor. The heat dissipation plates are made of, for instance, aluminum in a strip form herein. The plates have a longer width than that of the field winding 10 and have about the same length as the straight section in the width direction of the magnetic pole. When the plates are rolled in or inserted in the field winding 10, they are projected from the outer peripheral surface 8 of the field winding 10.

As described above, since the plates are rolled in or inserted in the field winding 10, a part of the plates is projected from the outer peripheral surface 8 of the field winding 10, thus increasing a radiating area where heat exchange with cooling air inside a synchronous is performed. Then, the heat that is generated by the pillar copper wire 5

near the center on the inner periphery of the field winding 10, is transmitted through the heat dissipation plates 11, and radiation is effectively performed. Accordingly, a thermal grade inside the field winding 10 is reduced, thereby lowering the temperature of the field winding 10 as a whole.

Therefore, by the configuration as mentioned above, a radiating area increases and a path for thermal conduction increases, thus lowering a temperature grade in the width direction 7 of the field winding 10. Accordingly, the field winding can lower the increase in temperature of the field winding 10 as a whole more than the conventional field winding 1. When the increase in temperature is not a problem with a conventional configuration, a field current may be increased by about 10 to 24% by a field circuit in the same size.

Although the heat dissipation plates 11 are in a strip form in the above-noted embodiment, they may have a notch 11a as shown in Fig. 3. This notch 11a is used to insert a conventional coil bracket between poles to prevent the field winding 10 from being released when a core length is long.

Efficacy of the Invention

As explained above, the present invention can reduce the increase in temperature inside a field winding more than a conventional synchronous.

Generally, in making a synchronous lightweight and compact, field current increases and the increase in temperature of a field winding tends to be higher. However, by the adaptation of the present invention, the increase in temperature of a field winding may be reduced, and output may be increased even with the same configuration. Additionally, with the same output, a miniature and lightweight synchronous may be provided.

4. Brief Explanation of the Drawings

Fig. 1 is a cross-sectional view, showing a part of one embodiment of the present

invention. Fig. 2 is a perspective view, showing a heat dissipation plate for use in the embodiment of the present invention. Fig. 3 is a perspective view, showing a heat dissipation plate that is different from that in Fig. 2. Fig. 4 is a view, explaining the operations of the present invention. Figs. 5a and 5b are views, explaining the operations of the present invention that are different from Fig. 4: Fig. 5a shows a conventional field winding and Fig. 5b shows a field winding of the present invention. Fig. 6 is a cross-sectional view, showing a part of a conventional salient-pole rotary-field synchronous.

2... field core 3... magnetic pole insulation

4a, 4b... insulation collar 5... pillar copper wire

8... outer periphery 10... field winding

11... heat dissipation plate

Agent Attorney (illegible) and one other

TO: Käty Rohr

FROM: Roger Lewis

(First of 2 Patent Translations)

被覆を施した平角銅線5を巻回して構成された界磁巻線1の場合、幅方向7に巻数が多いほどこの幅方向7の温度勾配が大きくなり、外周面8における放熱及び磁極鉄心2への熱伝達により界磁巻線1の冷却を行うが、この温度勾配により界磁巻線1全体の温度が上昇し、小形，軽量化を妨げる要因となっており、この解決が望まれていた。

本発明は、界磁巻線の幅方向の巻回数が多い場合でも熱勾配を低減させ、界磁巻線全体の冷却能力向して小形，軽量化を図った突極回転界磁形同期機を提供することを目的としている。

〔発明の構成〕

（課題を解決するための手段）

本発明は、絶縁被覆を施した導体を巻回して構成した界磁巻線を有する突極回転界磁形同期機に於て、界磁巻線を構成する導体間に放熱板を挿入又は巻き込んで一体的に設け、且つこの放熱板の一部を界磁巻線の外周面より突出させる様にしたものである。

（作　用）

界磁巻線の導体間に放熱板を挿入又は巻き込んで設けているから、従来の界磁巻線に比較して温度勾配を大幅に低減することができる。放熱板無しの界磁巻線の平均を 1.0とし、基準化した界磁巻線内部の幅方向温度分布を、放熱板無しと放熱板有りのそれぞれの場合について比較した一例を第4図に示す。

温度勾配が低減されるのは、従来の界磁巻線は第5図(a) に示す様に、例えば平角銅線の様な導体には絶縁被覆が施されている為、熱伝達がスムーズでないこと及び熱伝達経路が主としてこの平角銅線の幅方向素線間であるが、本発明の界磁巻線は同図(b) に示す様に、放熱板が界磁巻線の外周面より突出している為、冷却風により熱交換される放熱面積が増加すること、又、磁極の半径方向（第6図に符号6で示す）に対し、放熱板が挿入されている為、熱伝達経路が界磁巻線の幅方向（第6図に符号7で示す）だけでなく、放熱板と近接している平角銅線の熱が半径方向に伝達され、放熱板を通して幅方向に伝達され放熱されるからである。

（実施例）

以下、本発明の一実施例を図面を参照して説明する。第1図は、本発明の一実施例の要部を示す断面図である。

同図に於て、界磁巻線10は、磁極鉄心2の表面に磁極部絶縁3を施こし、絶縁カラー4a，4bを挿入し、絶縁被覆を施こされた平角銅線5を磁極鉄心2の表面に沿って半径方向6及び幅方向7に対し順次巻回して構成するが、この巻回に於て、回転子の半径方向の巻線2段おきに、第2図に示す様な放熱板11を平角銅線5と共に巻き込み又は挿入する。ここで、放熱板11は、例えばアルミニウム板から矩形状に形成されたもので、界磁巻線10の幅より長く、磁極の軸方向長さ直線部と同程度の長さとしたものであり、界磁巻線10に巻き込み又は挿入された場合に、界磁巻線10の外周面8より突出する様にする。

以上の様に放熱板11の巻き込み又は挿入により、界磁巻線10の外周面8より放熱板11の一部が突出するる為、同期機内部の冷却風と熱交換の行われる放熱面積が増加し、界磁巻線10の内周側、中央部近くの平角銅線5にて発生する熱が放熱板11を介して伝達され、放熱が効果的に行われ、界磁巻線10内部の温度勾配を低減することにより、界磁巻線10全体の温度を低下させることができる。

従って、以上の様に構成することにより、放熱面積が増加すること及び熱伝達の経路が増加するので、界磁巻線10の幅方向7の温度勾配を低減させることができ、これにより、界磁巻線10全体の温度上昇を従来の界磁巻線1より低減させることができる。これにより、従来の構成で温度上昇が問題にならない場合、同じ大きさの界磁回路にて約10～25%の界磁電流を増加させることができる。

尚、以上の実施例では放熱板11を矩形状としたが、第3図に示すように切り欠き11a を設けてもよい。この切り欠き11a は、鉄心長が長い場合に界磁巻線10の脱出防止の目的で公知のコイルブラケットを極間に挿入する際に用いられる。

〔発明の効果〕

以上説明した様に本発明によれば、界磁巻線の温度上昇を従来の構成のものより低減させることができる。

一般に、同期機小形，軽量化を図る場合、界磁の励磁電流が増加し界磁巻線の温度上昇が大きくなる傾向があるが、本発明の適用により界磁巻線の温度上昇低減を図ることが可能となり、同一形格であっても出力の増加を図ることができ、又、同一出力の場合小形，軽量化された同期機を提供することが可能となる。

4．図面の簡単な説明

第1図は本発明の一実施例の要部を示す断面図、第2図は本発明の一実施例に用いる放熱板を示す斜視図、第3図は第2図と異なる放熱板を示す斜視図、第4図は本発明の作用を示す説明図、第5図(a)(b)は第4図と異なる本~~考案~~発明の作用の説明図で、(a)は従来の界磁巻線、(b)は本発明の界磁巻線の場合を示し、第6図は従来の突極回転界磁形同期機の要部を示す断面図である。

2…界磁鉄心、　　3…磁極部絶縁、

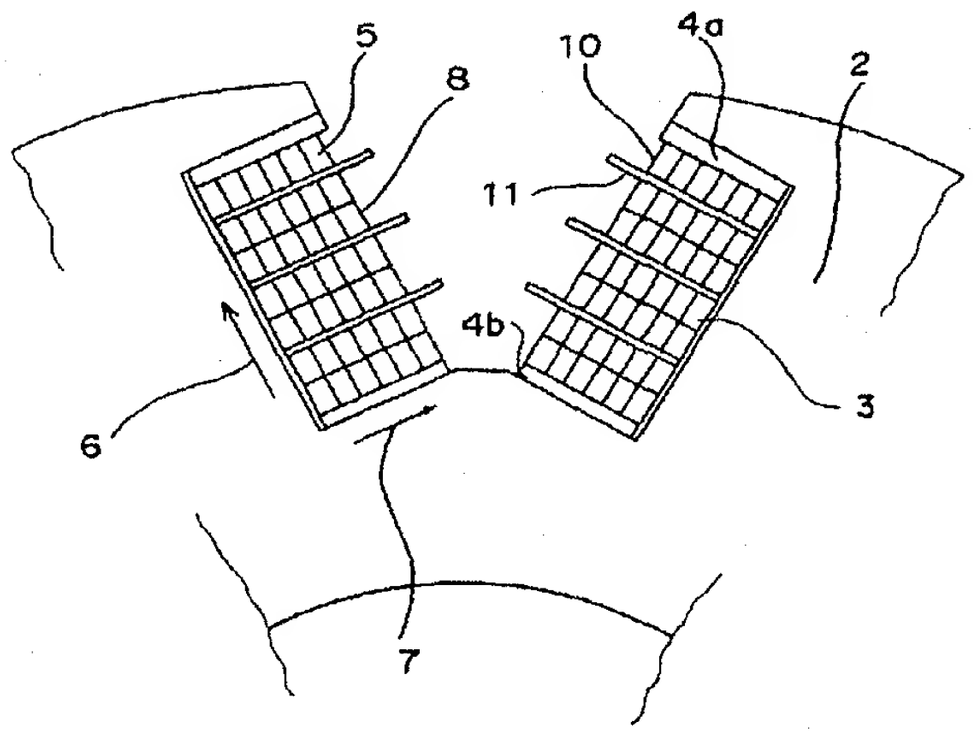
4a，4b…絶縁カラー、　5…半角銅線、

8…外周面、　　10…界磁巻線、

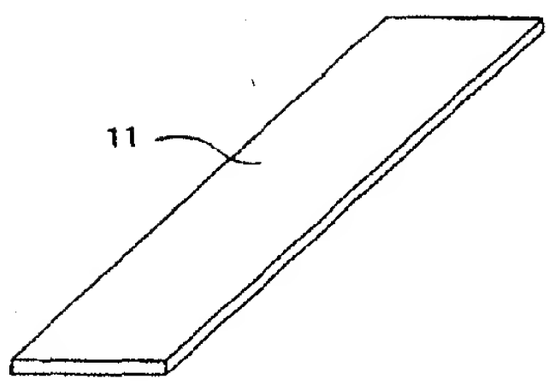
11…放熱板。

代理人　弁理士　猪　股　祥　晃

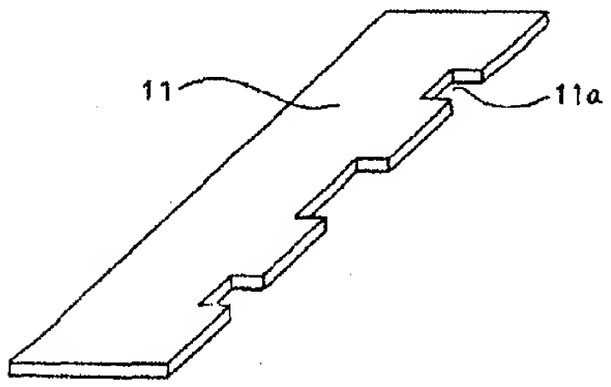
（ほか1名）



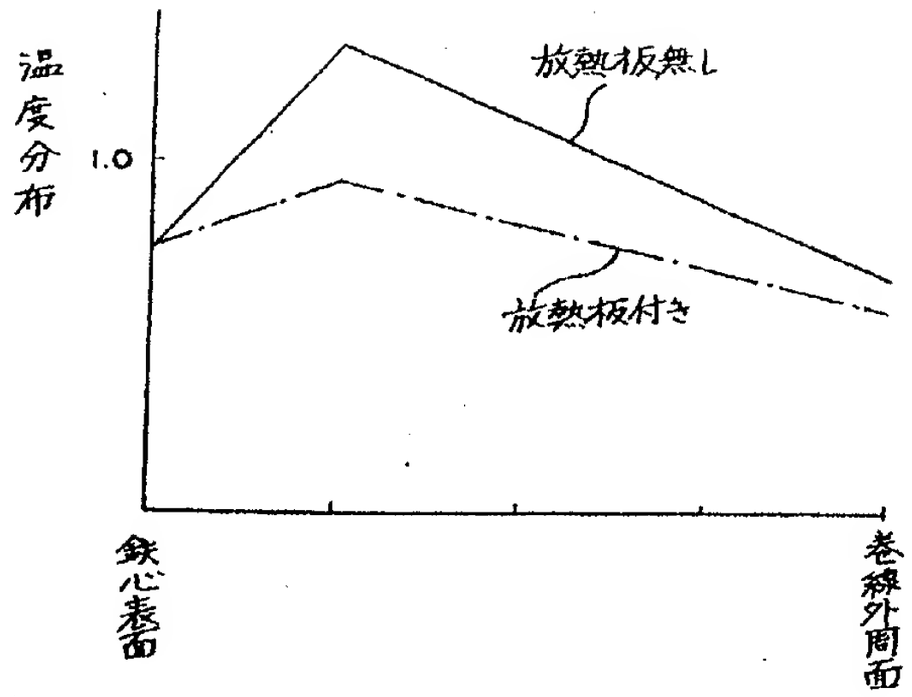
第　1　図



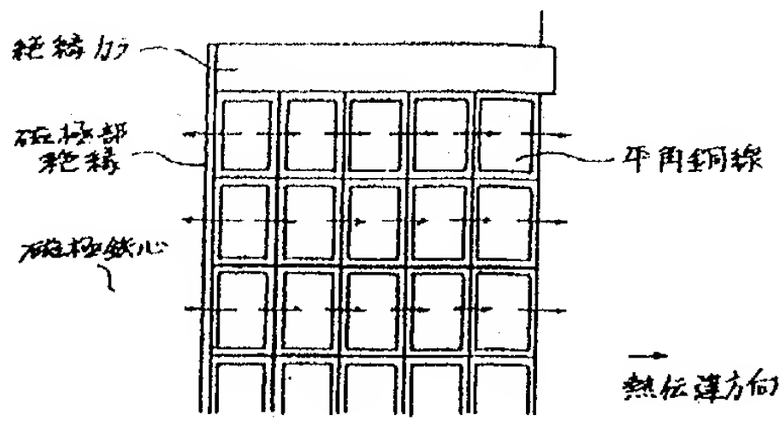
第　2　図

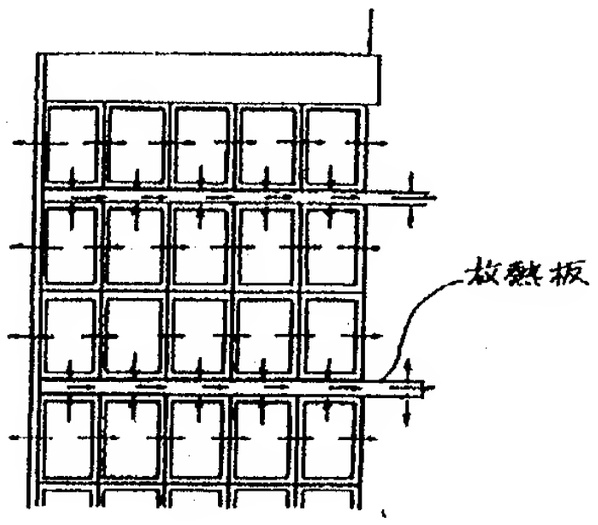


第　3　図

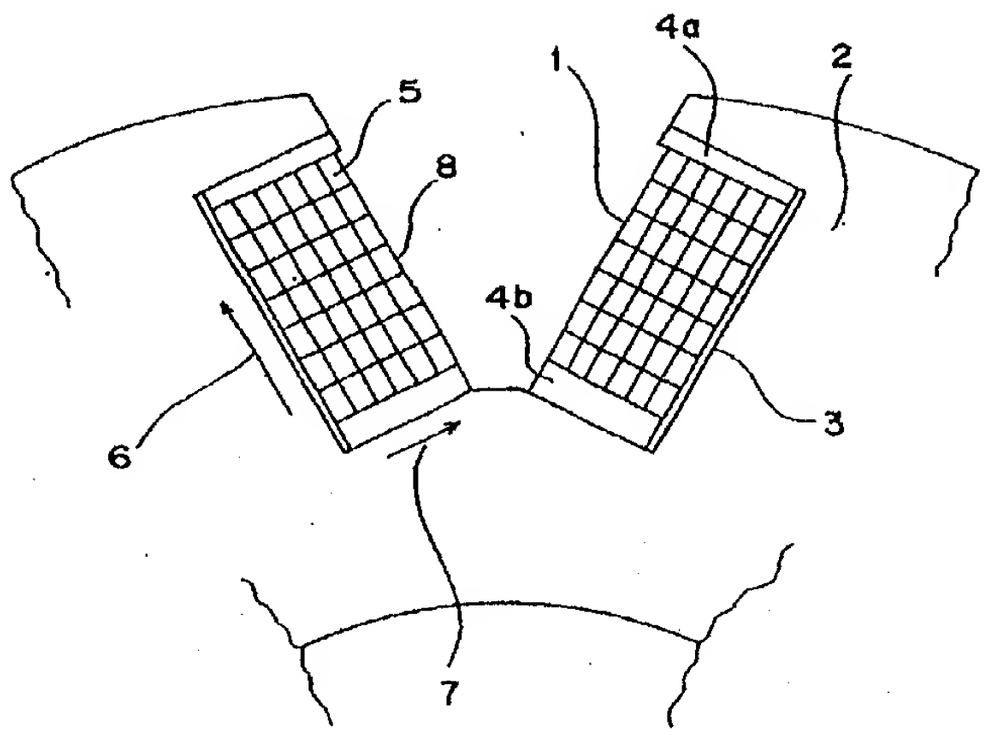

温度分布
1.0
放熱板無し
放熱板付き
鉄心表面
巻線外周面

第 4 図


絶縁物
磁極部絶縁
磁極鉄心
平角銅線
熱伝導方向
(a)


放熱板
(b)

第 5 図


1
4a
2
5
8
4b
3
6
7

第 6 図

CLIPPEDIMAGE= JP402290138A
PAT-NO: JP402290138A
DOCUMENT-IDENTIFIER: JP 02290138 A
TITLE: SALIENT-POLE ROTARY-FIELD SYNCHRONOUS MACHINE

PUBN-DATE: November 30, 1990

INVENTOR-INFORMATION:
NAME
KANAI, HITOSHI

ASSIGNEE-INFORMATION:
NAME COUNTRY
TOSHIBA CORP N/A

APPL-NO: JP01105840
APPL-DATE: April 27, 1989

INT-CL_(IPC): H02K003/24
US-CL-CURRENT: 310/52

ABSTRACT:

PURPOSE: To reduce thermal grade even if a field winding has a large number of
turns, to improve the cooling capacity of the whole of the field winding
mentioned above and to make it lightweight and compact by integrally inserting
or rolling in heat dissipation plates among conductors of

which the field
winding consists, and projecting a part of the heat dissipation plate from the
outer peripheral surface of the field winding mentioned above.

CONSTITUTION: A field winding 10 is such that a magnetic pole insulation 3 is
applied to the surface of a magnetic pole core 2, insulating collars 4a and 4b
are inserted, and a pillar copper wire 5 covered with an insulated coating is
subsequently wound up in the radial direction 6 and widthwise 7 along the
surface of the magnetic pole core 2. In the event of the winding up, heat
dissipation plates 11 are rolled-in or inserted together with the pillar copper
wire 5 every two steps of radial windings of a rotor. At that time, the heat
dissipation plate 11 has a longer width than that of the field winding and has
the same length as the axial length of the magnetic pole, and when it is rolled
in or inserted in the field winding 10, it is projected from the outer
peripheral surface 8 of the field winding 10.

COPYRIGHT: (C)1990,JPO&Japio

⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　平2−290138

⑤1Int.Cl.⁵	識別記号	庁内整理番号	⑬公開　平成2年(1990)11月30日
H 02 K 3/24	P	7829−5H	

審査請求　未請求　請求項の数 1　（全4頁）

⑤4発明の名称　突極回転界磁形同期機

⑳特　願　平1−105840
㉒出　願　平1(1989)4月27日

⑦2発明者　金井　均　神奈川県横浜市鶴見区末広町2−4号　株式会社東芝京浜事業所内
⑦1出願人　株式会社東芝　神奈川県川崎市幸区堀川町72番地
⑦4代理人　弁理士　猪股　祥晃　外1名

明　細　書

1．発明の名称

突極回転界磁形同期機

2．特許請求の範囲

絶縁被覆を施した導体を巻回して構成した界磁巻線を有する突極回転界磁形同期機に於て、前記界磁巻線を構成する前記導体間に放熱板を挿入又は巻き込んで一体的に設け、且つこの放熱板の一部を前記界磁巻線の外周面より突出させるようにしたことを特徴とする突極回転界磁形同期機。

3．発明の詳細な説明

〔発明の目的〕

（産業上の利用分野）

本発明は、突極回転界磁形同期機に係り、特にその界磁巻線の冷却，放熱能力向上した構造に関するものである。

（従来の技術）

第6図は、絶縁被覆を施こされた平角銅線を巻回して界磁巻線を構成し、この界磁巻線を装着した突極回転界磁形同期機の要部を示す断面図である。

同図に示すように界磁巻線1は、磁極鉄心2の表面に磁極部絶縁3を施した後、絶縁カラー4a，4bを挿入し、絶縁被覆を施こされた平角銅線5を磁極鉄心2の表面に沿って半径方向6及び幅方向7に対し、段を形成する様に巻いて行く。

ところで、界磁巻線1は、同期機の運転時、励磁電流を流すことにより発熱する。この発熱は、磁極鉄心2及び界磁巻線1の外周面8に伝達され気中に放熱される。同期機内部の冷却風は、この放熱作用を促進させ、界磁巻線1の冷却作用効果を向上させる。この場合、放熱面となる界磁巻線1の外周面8にのみ冷却風が流れるので、界磁巻線1の幅方向7に対し巻数の多い場合には、界磁巻線1を構成する絶縁被覆部分で熱伝達による温度勾配を生じる。これにより、界磁巻線1の幅方向7に対し、温度勾配が大きくなる。

（発明が解決しようとする課題）

同期機の小形，軽量化を図るためには、界磁巻線1の冷却が重要なポイントの1つである。絶縁